A TPC Simulator for the NA49 Experiment

Glenn Cooper, Milton Toy, and the NA49 Collaboration

NA49 is based on four TPC's, which previously were used as independent detectors. Recently, the data analysis was revised to treat the TPC's as one detector in which particle tracks are connected between the TPC's. Supporting this new analysis, two TPC simulation packages were unified into an improved global simulation. This package will be used to evaluate tracking efficiency and physics backgrounds by reconstructing both (i) simulated tracks embedded in raw data and (ii) simulated event generator events.
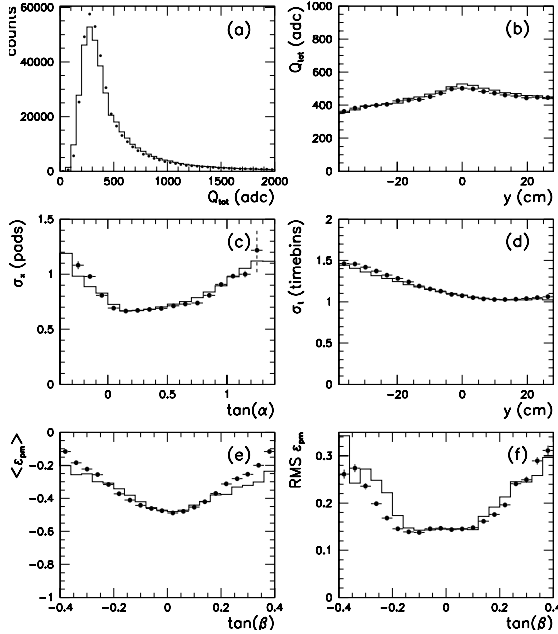
uses a parameterized response plus a method for distributing ionization along tracks which cross readout planes at non-normal angles. The new package adds effects necessary to simulate the VTPC's which are located inside dipole magnets. These effects include modified diffusion of track ionization and $\mathbf{E} \times \mathbf{B}$ distortions. Also, saturation of the TPC readout electronics, especially important for the VTPC's where the track density is highest, is simulated.

The simulation was compared to data in detail. A few tunable parameters were adjusted to improve the agreement. The characteristics studied were ionization cluster size, shape, and amplitude, cluster residuals relative to the reconstructed track, and number of clusters per track, all as a function of position in the TPC's and track geometry. Sample results are shown in Figures 1 and 2. Overall, the agreement of the simulation and the real data is good, which is required for calculation of accurate efficiency and background corrections.
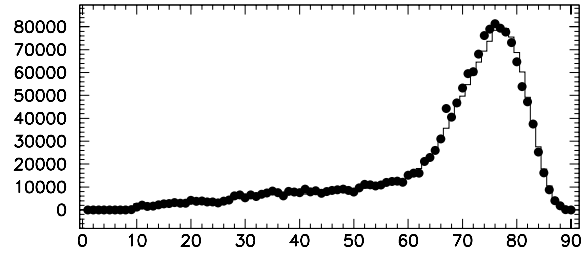

Figure 1: Comparison of actual (−) and simulated (•) cluster characteristics: (a) total charge Q_{tot}, (b) Q_{tot} vs. TPC height y, (c) horizontal width σ_x vs. readout wire crossing angle $\tan(\alpha)$, (d) vertical width σ_t vs. y, and (e) mean normalized eccentricity $\langle \epsilon_{pm} \rangle$ and (f) RMS ϵ_{pm} vs. pad crossing angle $\tan(\beta)$.

The new simulation is based on MTSIM[1], which simulates the the two MTPC's outside the experiment's dipole magnetic field. MTSIM

Figure 2: Comparison of the number of clusters on actual (−) and simulated (•) tracks in MTPC's.

References

[1] M. Toy and the NA49 Collaboration, NSD Ann. Rep. 1994, 135.